

EXECUTIVE SUMMARY

The Uranium Mass Balance Project was conducted at the Rocky Flats Environmental Technology Site (Site) in accordance with the Department of Energy (DOE) *Project Plan for Historical Generation and Flow of Recycled Uranium* in the DOE Complex, dated February 2000. The Site processed both depleted uranium (DU) and highly enriched uranium (HEU) materials in fulfilling the DOE mission of fabricating components and assemblies for the U.S. nuclear weapons program.

The DU materials were processed from 1953 through 1993. The Site has complete records regarding the receipts and shipments of uranium materials for all years. According to these records, the Site received a total of 8,029 metric tons (MTU) of DU metal from 103 individual supplier facilities. Approximately 90% of the DU metal, (7,173 MTU) was received from the DOE facilities at Fernald and Paducah. Regarding the portion of the metal material shipped to the Site that was derived from the recycled uranium (RU) process, only 2.1 MTU (received from the Fernald facility) is known to have resulted from RU processing. Although the 2.1 MTU has been defined by Fernald as "low enriched" material (containing slightly more than 0.7 % U235), the Site considered this material to be DU and it is included in the mass balance ledger for that material type.

No information has been received, or is expected, for the 857 MTU of metal material received from all other supplier facilities. The Site records indicate that this material is DU and, according to information from the DOE, Headquarters (DOE,HQ) project team members, DU metal is not likely to have been derived from the recycle process. The transuranic (TRU) and technetium (Tc) content information from Fernald for the 2.1 MTU of RU material (2.8 parts-per-billion (ppb) plutonium, 389 ppb neptunium, and 8550 ppb technetium) confirms that this material is below the level identified as *de minimis*. Based on information from the source sites, any material that was received that contained less than 3.0 ppb plutonium and was not subjected to a process that would concentrate the TRU was considered *de minimis*.

The Site processed HEU materials from 1953 through 1967. However, according to direction received from the RU project team members at DOE,HQ, HEU metal of the purity required for the weapons program would have not have recycle contaminants because of the processing steps to establish the enrichment and therefore is considered *de minimis*. For information purposes, the Site report does include descriptions of the buildings and processes associated with HEU metal production. Mass balance data for the HEU shipments and receipts was collected but is classified and is not being provided. No attempt has been made to share Site receipt data with the HEU metal supplier facilities. A small quantity of RU HEU material (200 kilograms), in the form of uranyl nitrate, received at the Site in 1955 from the Idaho facility, was derived from a recycle process. However, the data (0.007 ppb plutonium, 2.5 ppb neptunium, and 9.12 ppb technetium) for this material confirms that the constituent levels were *de minimis*.

The Site evaluation of the DU production processes identified two processes that had the potential for concentrating or releasing transuranics or fission products related to worker exposure. The first was the vacuum melting and casting process used for DU and DU alloy materials. This process produced a dross or skull which was believed to have some potential for accumulating contaminants. During production the Site was not required to and did not perform analyses for constituents and must rely on input from outside organizations regarding the results of the melting and casting process. The Site has received information from the Fernald

Environmental Management Project (FEMP) and from the Specific Manufacturing Capability Project (SMC). According to the FEMP information, the melting and casting process can result in higher radiation levels in the skull due the separation of the higher uranium daughter products of thorium and protactinium. The FEMP report also provides some evidence of Plutonium (Pu) and Neptunium (Np) concentration during the casting operation. More recent data reported by SMC indicates that no accumulation of transuranics or fission products occur as a result of the melting and casting process.

The second process involved the conversion of machine turnings and dross from the melting operation to oxide through the use of chip roasting equipment. Although the Site has no direct analytical information concerning the chip roasting process, routine monitoring of the building ventilation system was performed and the historical emission data indicates no increased level of transuranic emissions.

A health physics worker program started with production in 1953. The Site records include bioassay and external exposure for workers. The health physics program is believed to be sufficient to identify any contribution to worker exposure, regardless of source.

The Site report also includes data on the historical emissions from the Site, including HEU and DU, covering the period from 1952 to 1989. This information is contained in a report prepared for the Colorado Department of Public Health and Environment in March 1994. The report revised the estimated releases prior to 1961 by using raw data from plant log books which included the emissions from all the uranium production buildings. The data show a continual decrease in the emissions over the entire period with very low levels starting in 1971 and continuing through 1989. The report also provides estimates of environmental releases from open burning of contaminated oil during 1957 to 1965. In summary, the releases to the environment from both the HEU and DU operations were very small. The locations where burning and burial of uranium occurred have been identified. Plans for remediating these areas are included in the Rocky Flats Closure Project. Remediation of one burial location, Trench 1, has been completed.

Since all DU materials shipped to the Site contained *de minimis* levels of TRU and Tc constituents, the Site RU project report was prepared in accordance with the abbreviated format for *de minimis* streams, i.e., Sections 3, 4, and 5, as described in the Project Plan are not included.